M dwarf flares

and their impact on exoplanet habitability

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Stellar flares

A stellar flare is a sharp and local increase in the brightness of a star. It is caused by the release of stored magnetic energy in the star's chromosphere.

Stellar flares can increase the brightness of Main Sequence stars up to x90 in optical and up to x14000 in UV. Superflares can release energies of up to 10^{36} erg.

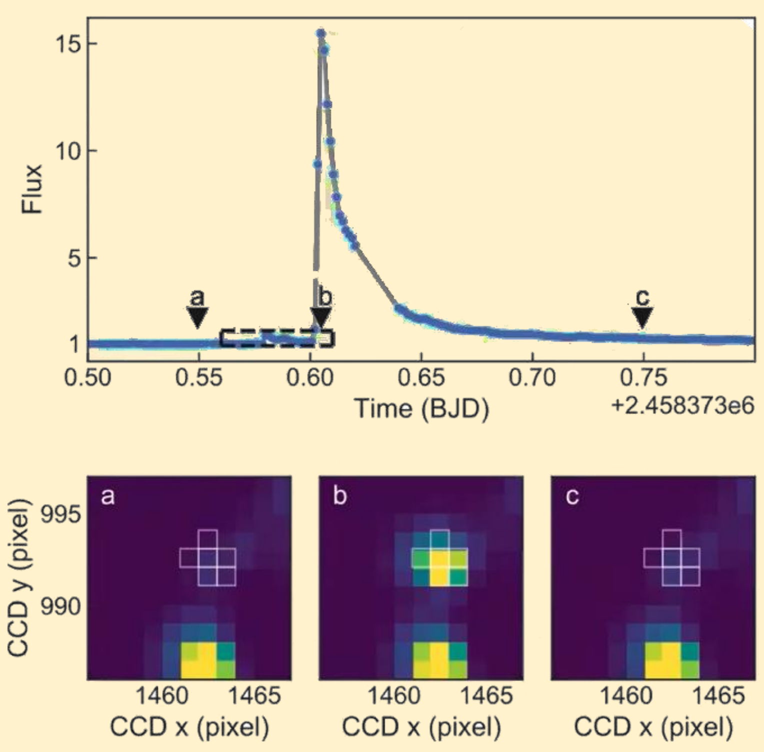


Figure 1: Example of an optical flare, observed as a light-curve (top) and CCD images (bottom) [1].

M dwarfs are strongly active stars and can display powerful flares frequently. Such flares can have a heavy impact on the surrounding exoplanets, especially because of their small orbit.

CubeSat mission

We propose to use a CubeSat to observe UV and optical flares to compare flux ratios in different bands and filters.

Observing in both bands will allow us to measure the difference in flux ratios and complement current large scale survey operating in the optical with UV data from space.

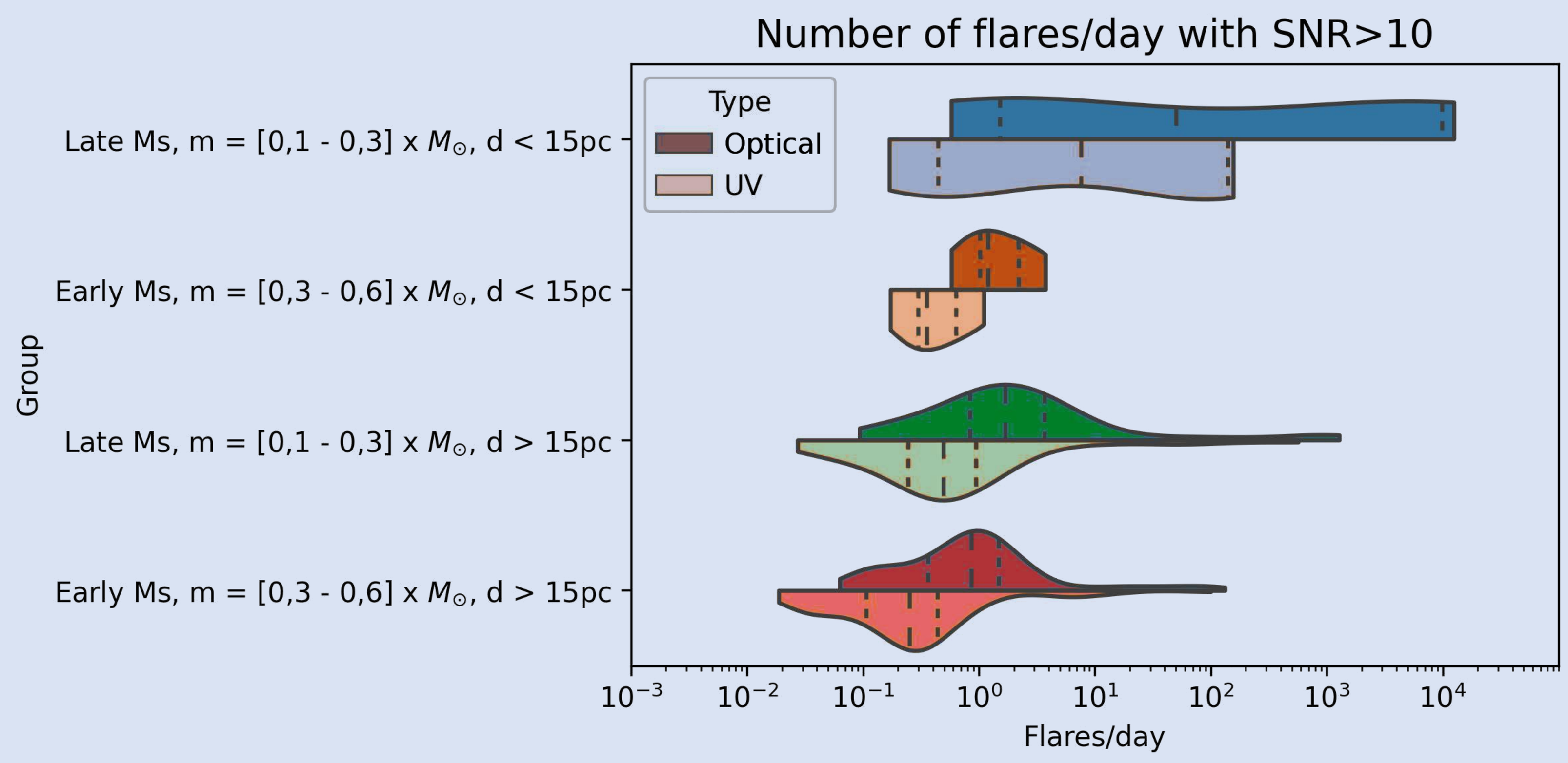


Figure 2: Number of flares detectable by the CubeSat, calculated with data from the TOI catalog complemented with injected flares [2].

Fast optical flares

Fast optical flares (with a duration of a few seconds) have recently been observed for the first time.

We are currently conducting a ~1-2 second cadence fast flares survey at the TFRM [3] to increase their census.

This new population of flares would allow us to observe more complex flares and input new data in the current flare formation models.

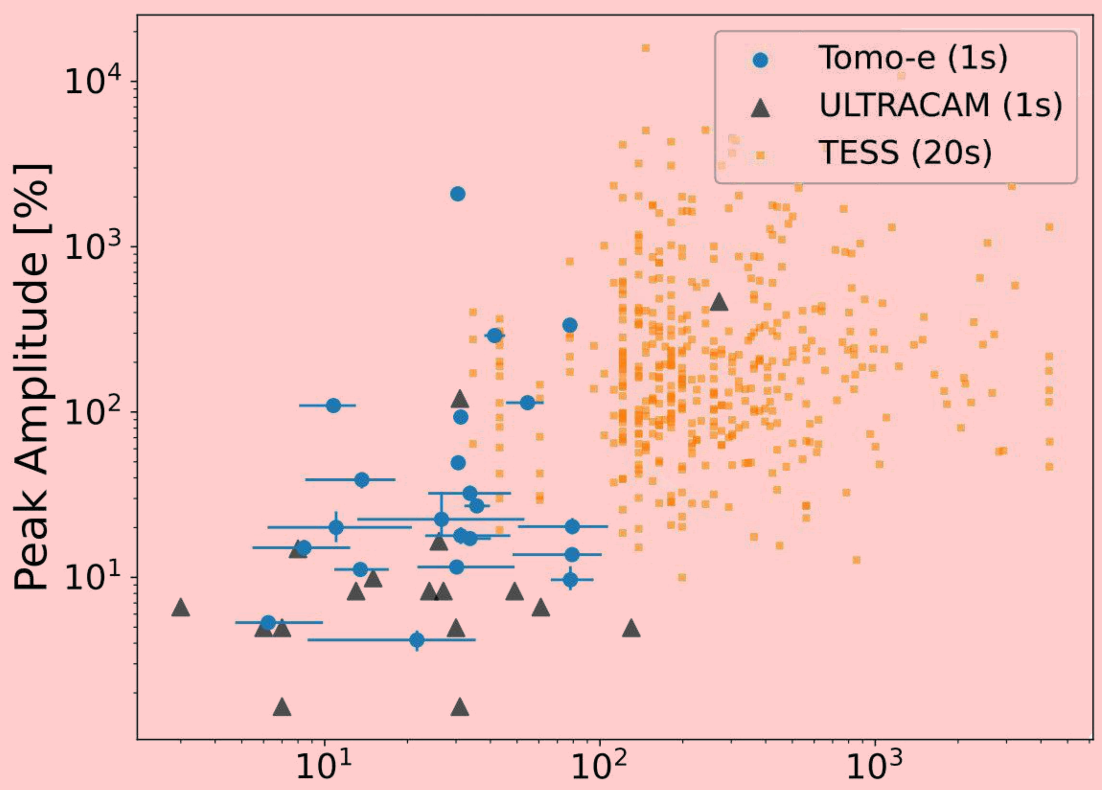


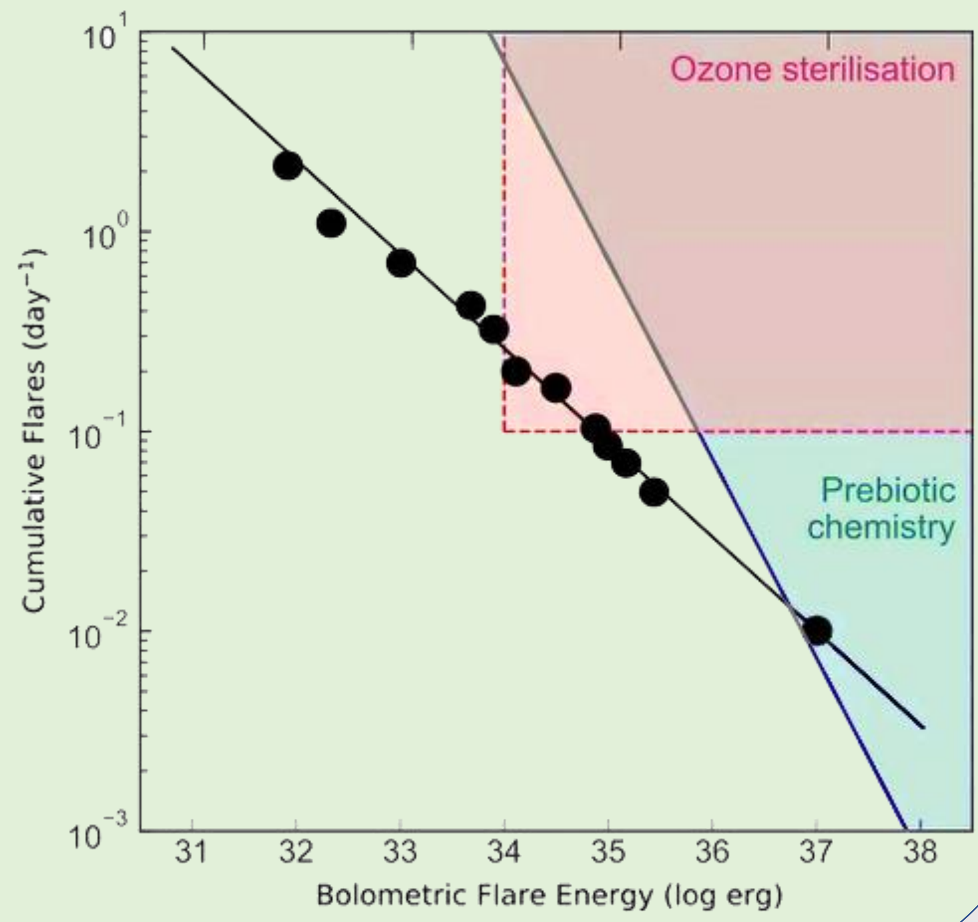
Figure 3: Comparison of the TESS observations (yellow) and flare observations realised by fast cadence survet (blue) [4].

Impact on exobiology

Strong and frequent flaring can strip off exoplanets' atmospheres, photo-dissociate biosignautres and allow lethal doses of UV light to reach the surface [5].

But sufficient UV radiation is required to turn inorganic matter (mineral dust, meteoritic dust, etc) into prebiotic precursors (sugars, nucleobases, carboxylic acids, etc). In the case of M dwarfs, this UV radiation can only come from flares [6].

Figure 4: Example of a Flare Frequency Distribution (FFD) for one hypotetical exoplanet [1].



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